National Aeronautics and Space Administration

Testing of Space Suit Materials for Mars

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HAT: 6.2B-E **TA:** 6.2 Extravehicular Activity Systems **TRL:** start 2 / current 4

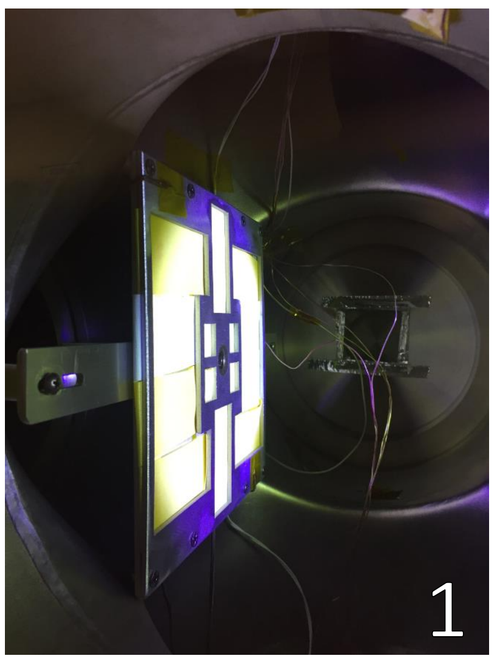
ICA PROJECT OVERVIEW

Human missions to Mars may require radical changes in our approach to EVA suit design. A major challenge is the balance of building a suit robust enough to complete 50 EVAs in the dirt under intense UV exposure without losing mechanical strength or compromising its mobility. We conducted ground testing on both current and new space suit materials to determine performance degradation after exposure to 2500 hours of Mars mission equivalent UV. This testing will help mature the material technologies and provide performance data that can be used by not only the space suit development teams but for all Mars inflatable and soft goods derived structures from airlocks to habitats.

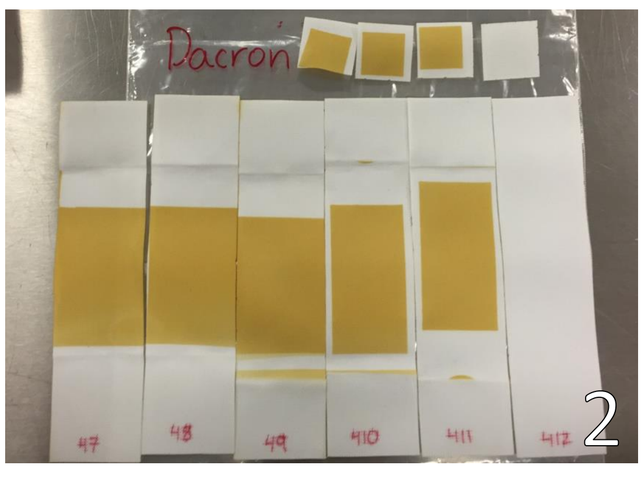
INNOVATION

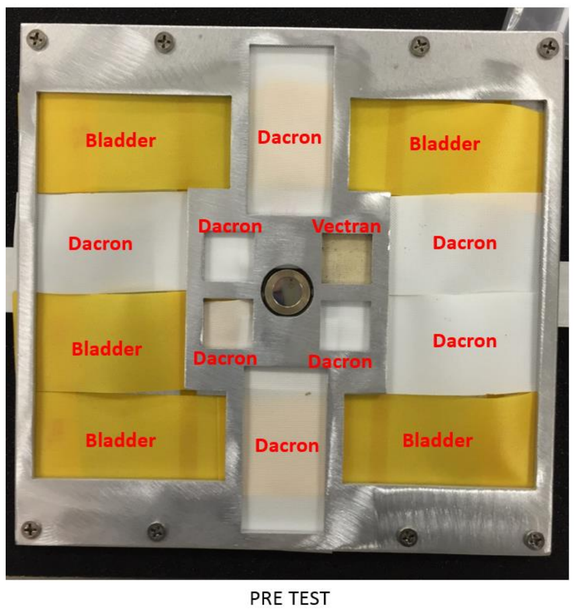
This technology would enhance our understanding of how current and new suit materials would degrade after being exposed to the Mars UV environment.

PICTURES FROM RADIATION TESTING

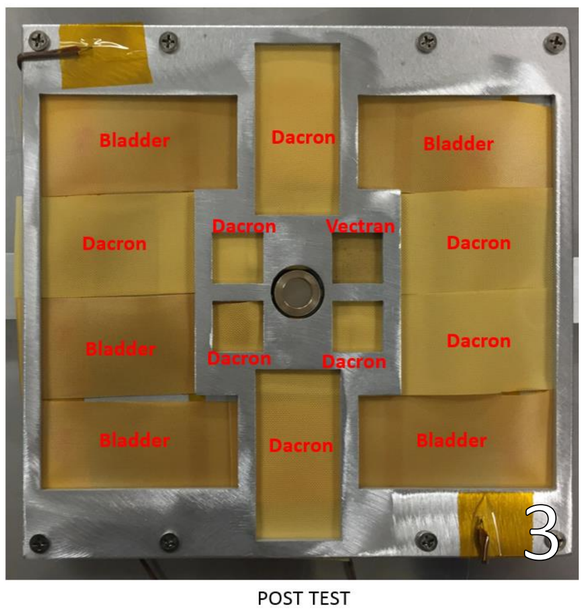


1.) Samples mounted into a vacuum chamber with the UV spotlight turned on.
2.) Post-radiation Dacron samples saw significant discoloration compared to pristine specimens.
3.) Side by side picture of a sample plate pre- and post-radiation.





PRE TEST

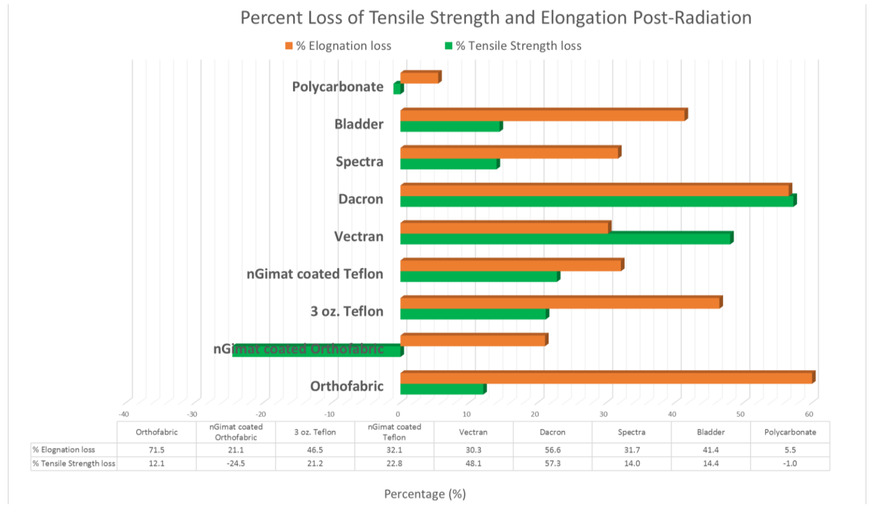


POST TEST

OUTCOME / RESULTS

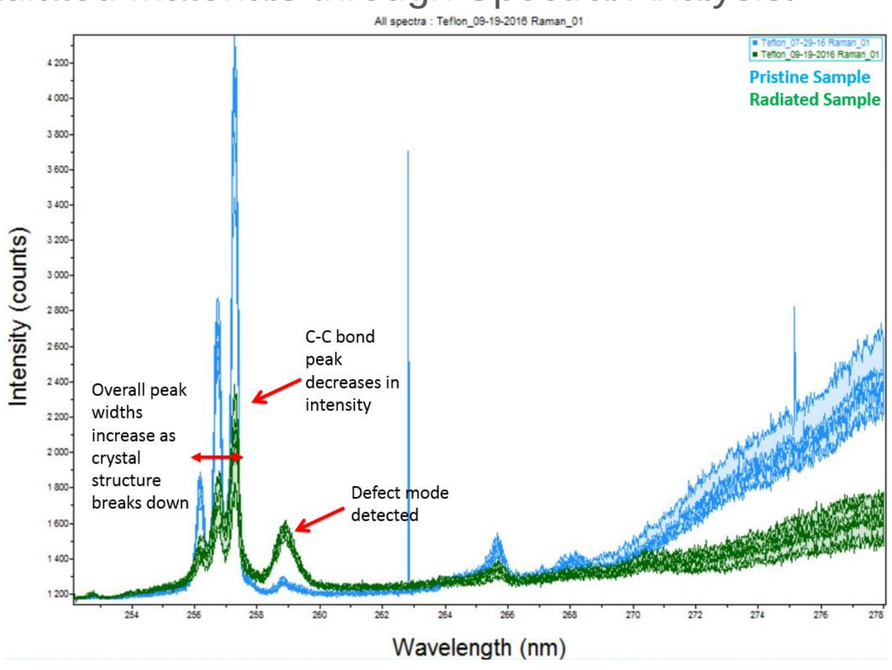
All samples were measured for mass, tensile strength, and chemical composition before and after radiation.

- Mass loss was insignificant (less than .5%) among the materials.
- Most materials loss tensile strength after radiation and became more brittle with a loss of elongation.



	Orthofabric	nGimat coated Orthofabric	3 oz. Teflon	nGimat coated Teflon	Vectran	Dacron	Spectra	Bladder	Polycarbonate
% Elognation loss	71.5	21.1	46.5	32.1	30.3	56.6	31.7	41.4	5.5
% Tensile Strength loss	12.1	-24.5	21.2	22.8	48.1	57.3	14.0	14.4	-1.0

- Changes in chemical composition were seen in all radiated materials through Spectral Analysis.



PARTNERSHIPS / COLLABORATIONS

To complete this testing we partnered with Marshall Space Flight Center, Jet Propulsion Laboratory, and EC2 in the Crew and Thermal Systems Division.

FUTURE WORK

JPL has invited us to participate in the SHERLOC instrument of the Mars 2020 rover to enable in-situ testing of candidate space suit materials. After ICA, we will work with the SHERLOC team on the mounting interface of the space suit materials to the calibration target on the rover. SHERLOC data will provide truth data against which our ground results can be compared and materials models refined.